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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Number: US 6,724,179 B2

Issued: April 20, 2004

Inventors: Kingsley et al.

Title of Invention: OPTO-ELECTRIC DEVICE FOR MEASURING THE ROOT-MEAN-SQUARE
VALUE OF AN ALTERNATING CURRENT VOLTAGE

Commissioner for Patents
P.O. Box 1450
Alexandria, VA22313-1450

Certificate
MAY 21 2004
of Correction

ATTENTION: Certificate of Correction Branch

REQUEST FOR CERTIFICATE OF CORRECTION OF PATENT

Sir:

Applicants request correction of the errors as listed in Form PTO/SB/44 (07-03).

1. Attached in duplicate is Form PTO/SB/44 (07-03; 2 pages) with at least one copy being suitable for printing.
2. The paragraph in which the errors occur in the electronically filed application are as follows (a copy of the electronically "as filed" paragraph is enclosed and hi-lighted in yellow):

Patent	Application Paragraph	Errors
Column 4, line 38	[0034]	"Input" should be - input-
Column 6, line 11	[0043]	" $(1/\bar{v}_{in})$ " should be $-(1/\bar{V}_{in})-$
line 12	[0043]	" $(V_{in}^2 \times 1/\bar{v}_{in})$." should be $-(V_{in}^2 \times 1/\bar{V}_{in})-$
line 17	[0043]	" (\bar{v}^2_2) " should be $-(\bar{V}^2)-$.
line 18	[0043]	" (\bar{v}^2_2) " should be $-(\bar{V}^2)-$.
Column 15, line 19	Claim 5 [c5]	"chat" should be -that-.

21 MAY 2004

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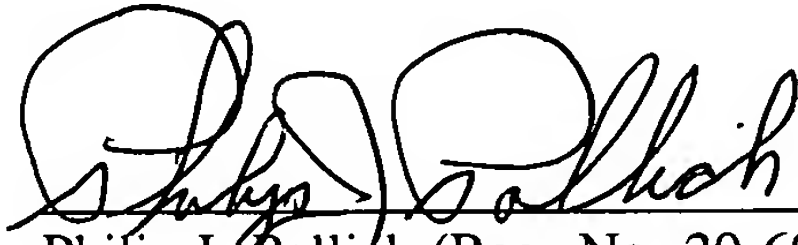
3. It is believed that no fee is due as all errors appeared in the PTO printing process or, with respect to the special characters, in the electronic filing process. However, if it is determined that a fee is due, the Commissioner is hereby authorized to charge deposit account number 13-3393 for any fees that may be due.

4. Please mail the Certificate to:

Philip J. Pollick
Kremblas, Foster, Phillips & Pollick
P.O. Box 141510
Columbus, Ohio 43214-6510

5. If it in any way would help with the resolution of the matter, applicants' attorney would appreciate a phone call at 614 263 8990.

May 14, 2004
Date


Philip J. Pollick (Reg. No. 29,692)
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Columbus OH 43214

CERTIFICATE OF MAILING (37 CFR 1.8a)

I hereby certify that the correspondence identified above is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Certificate of Correction Branch, Commissioner for Patents, P.O. Box 1450, Alexandria VA 22313-1450 on May 14, 2004 Printed name of person signing: Mary L. Pollick

Signature Mary L. Pollick

UNITED STATES PATENT AND TRADEMARK OFFICE CERTIFICATE OF CORRECTION

PATENT NO. : US 6,724,179 B2
DATED : April 20, 2004
INVENTOR(S) : Kingsley et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 4,

Line 38, after the word "an", delete the word "Input" and substitute therefor the word – input –.

Column 6,

Line 11, after the word "line", delete the term " $62 \left(1/\bar{V}_{in} \right)$ " and substitute therefor the term – $62 \left(1/\bar{V}_{in} \right)$ –.

Line 12, after the term "line 46, i.e.," delete the term " $(V_{in}^2 \times 1/\bar{V}_{in})$," and substitute therefor the term
– $(V_{in}^2 \times 1/\bar{V}_{in})$. –

Line 17, after the term "line 52", delete the term " (\bar{V}^2) " and substitute therefor the term – (\bar{V}^2) –.

Line 18, after the term "This voltage", delete the term " (\bar{V}^2) " and substitute therefor the term – (\bar{V}^2) –.

Column 15,

Line 19, after the word "voltage", delete the word "chat" and substitute therefor the word – that –.

MAILING ADDRESS OF SENDER:

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PATENT NO. US 6,724,179 B2

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This collection of information is required by 37 CFR 1.322, 1.323, and 1.324. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1.0 hour to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Attention Certificate of Corrections Branch, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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21 MAY 2004

[0034] Fig. 15 again gives two plots, the lower plot being a trace of an input signal and the upper plot being a trace of the optical receiver output when the Mach-Zehnder bias point is not located exactly at the null.

[0043] Alternatively, and as shown in Fig. 3, the inverse voltage in line 62 produced by the inverse ratio circuit 60 can be processed by a multiplier circuit 44 to provide a linear output voltage in line 46. That is, the voltage in line 42 which is a squared voltage of V_{in} , i.e. V_{in}^2 is multiplied by the inverse average voltage in line 62 ($1/\bar{V}_{in}$) to give a linear voltage in line 46, i.e., ($V_{in}^2 \times 1/\bar{V}_{in}$). As shown in Fig. 4, the same result can be achieved by eliminating the inverse ratio circuit 60 and returning the output voltage from the averager and using it as a divider in a divider circuit 48 that divides the squared voltage by the averaged output voltage in line 52, i.e., (V_{in}^2/\bar{V}_{in}). In Fig. 5, the voltage in line 52 (\bar{V}^2) is the average of the "squared" voltage in line 42 (V^2). This voltage (\bar{V}^2) is processed with a square root circuit 56 to give the true rms output voltage V_{out} . As will be appreciated by those skilled in the art, the use of averager, divider, multiplier, and square root circuits is well known in the art as illustrated in R. B. Northrop, **Introduction to Instrumentation and Measurements**, CRC Press, Boca Raton, FL, 1997) all of which is incorporated by reference as if completely written herein. Figs. 2-4 illustrate what may be referred to as an implicit rms determination method while Fig. 5 illustrates an explicit rms determination method. Generally the use of an inverse ratio circuit as a control voltage for the light source intensity driver 24 as shown in Fig. 2 is the preferred mode of operation of the present invention as it affords a dramatic increase in the dynamic input range (10dB) and eliminates the "squared voltage output" handling by optical receiver 40 and the subsequent circuitry. Such large voltage outputs must be handled in varying degrees by the various circuits illustrated in Figs. 3-5.

[c5]

5. An opto-electric device for measuring the root mean square value of an alternating current voltage comprising:

a) an electric field-to-light-to-voltage converter comprising:

1) a light source;

2) an electro-optic material:

(a) receiving light from said light source;

(b) modulating said light; and

(c) providing a modulated light output;

3) an electric field applied to said electro-optic crystal to modulate said light from said light source to produce said modulated light output;

b) an optical receiver for receiving and converting said modulated output light from said electro-optic material to a first voltage that is proportional to a square of said electric field applied to said electro-optic material;

c) an averager circuit receiving said first voltage and providing a second voltage that is proportional to the average of said square of said electric field over a period of time;

d) an inverse ratiometric circuit receiving said second voltage from said averager circuit and returning a third voltage that is an inverse voltage of said second voltage to said electric field-to-light-to-voltage converter to produce an output voltage that is the root mean square voltage of said applied electric field;

e) an environmental container for said electro-optic material; and

f) a temperature control unit for maintaining a set temperature within said environmental container.